Department of Physics (M.Sc.I)

1. **TITLE:** Materials Characterization Techniques
2. **YEAR OF IMPLEMENTATION:** 2018
3. **PREAMBLE:**

Diploma in Materials Characterization Techniques is two year integrated course for post graduate students. The students from physic should be competent for new material characterization techniques.

In this diploma course students will be able to understand material identification through various characterizations like XRD, UV- VIS, Raman spectroscopy and AAS characterization techniques.

4. **GENERAL OBJECTIVES OF THE COURSE:**
   1. The students are expected to understand the characterization techniques.
   2. It is expected to inspire and boost interest of the students towards research.
   3. The candidate can develop research for society.
5. **DURATION:** One Year
6. **PATTERN:** Annual
7. **MEDIUM OF INSTRUCTION:** English
8. **STRUCTURE OF COURSE:**

Paper No and Name
CPT101: Material Characterization Techniques
CPL102: Practical
CPP103: Project

A) LIBRARY: Reference and Textbooks, Journals and Periodicals, Reference Books for Advanced Books for Advanced studies. - List Attached

B) SPECIFIC EQUIPMENTS: Computer, LCD, Projector, Visualizer, Smart board

C) Laboratory Equipments: 1. UV-Vis spectrophotometer 2. Origin Software 3. Four probe method 4. Spray prolepsis 5. SILAR Method

CPT 101: Material Characterization Techniques **(Credits: 4)**

Learning Objectives:

Students will able to:

1. understand the crystal structure by XRD.
2. study UV-VIS spectra.
3. study Raman spectra
4. study Atomic Absorption spectra

Unit 1:X-ray diffraction **(12)**

Introduction, Construction, principle and working of X-ray diffraction, Determination of crystallite size, texture coefficient. Various experimental techniques used for diffraction. Advantages and applications.

Unit 2:UV-Vis spectroscopy **(12)**

Introduction, principle and working, construction of UV-Vis spectrophotometer reflection, absorption, transmission analysis and band gap determination, Deviations from the Beer–Lambert law, advantages and uses

Unit 3:Raman spectroscopy **(12)**

Identification of molecular groups for radicals in solids, zero phonon mode of vibration, electron-phonon and phonon-phonon interactions, scattering geometry in Raman spectroscopy-Rayleigh scattering, Vibrational Raman spectroscopy, advantages and applications

Unit 4:Atomic Absorption Spectrometer (AAS) (12)

Theoretical principles of atomic absorption spectroscopy. Apparatus for measuring atomic absorption spectroscopy. Radiation sources. Flame and electro thermal atomization. Limitations in atomic absorption. Interferences. Comparison of absorption spectrometry techniques flame and graphite furnace. Quantitative Analysis.

Recommended Books:

1. Elements of X- ray diffraction By B. D. Cullity, (1956), Addison-Wesley Publishing company Inc., USA
2. Characterization techniques by ChatwalAnand
3. Modern Raman Spectroscopy: Practical Approach by Deon and Smith
4. Instrumental methods of analysis (V^{th} edition) by Willard, Merritt, DeanSettle

Learning Outcomes

Unit – I:

1. Student should able to understand principle and working of X-ray diffraction
2. Student should able to determine crystallite size, texture coefficient.
3. Student should able to understand advantages and applications of XRD technique.

Unit – II:

1. Understanding of working, construction of UV-Vis spectrophotometer
2. Student should able to understand reflection, absorption, transmission analysis.
3. Student should able to determine band gap energy.

Unit – III :

1. Understanding of identification of molecular groups for radicals in solid.
2. Student should able to understand Vibrational Raman spectroscopy
3. Student should able to understand concept of scattering geometry.

Unit – IV :

1. Student should able to understand apparatus for measuring atomic absorption spectroscopy.
3. Student should able to understand Radiation sources

CPL102: Practical (Credits: 4) (96)

1. To determine crystallite size of given thin film by using XRD pattern
2. To determine interplanar spacing of given thin film by using XRD pattern
3. To determine crystallite size of given powder.
4. To determine NRF of given thin film by using XRD pattern
5. To determine Lattice parameters of given thin film by using XRD pattern
6. To determine band gap of given material by using UV-Vis spectrophotometer
7. To determine band gap of given semiconducting material by using UV-Vis spectrophotometer and study quantum confinement effect
8. To study absorption and transmission of ZnO thin film by using UV-Vis spectrophotometer
9. To determine band gap of CdO thin film by two probe method
10. To determine band gap and activation energy of CdO thin film by four probe method
11. To determine band gap of Cu2O material by using UV-Vis spectrophotometer

12. To study absorption and transmission of TiO2 thin film by using UV-Vis spectrophotometer
13. To determine the resistivity of given sample at different temperatures to obtain the band gap energy.
14. To determine thermoelectric power of given n-type semiconductor
15. To determine thermoelectric power of given p-type semiconductor
16. To study the contact angles of aqueous and non-aqueous solutions on super hydrophobic material. (Aerogel)
17. Analyse the Raman spectra of given thin film
18. Analyse the Raman spectra of given powder.
19. Analyse the AAS spectra and measure concentration of its constituent components
20. To study the contact angles of aqueous and non-aqueous solutions on glass
21. Determine the thickness of given thin film by using gravimetric as well as surface profilometer.
22. To determine the particle size of CdSe and study quantum confinement effect using PL spectroscopy
23. Analyse the PL spectra of nano particle and determine the band gap of nano particle
24. Analyse the TGA data of given sample and determine annealing temperature

Reference Books:

1. Elements of X- ray diffraction By B. D. Cullity, (1956), Addison-Wesley Publishing company Inc.,USA
2. Instrumental methods of analysis (V^{th} edition) by Willard, Merritt, Dean Settle
3. Characterization techniques by Chatwal Anand
4. Modern Raman Spectroscopy: Practical Approach by Deon and Smith
5. Nanotechnology,principles and practices 3^{rd} edition 2015 by Sulbha K Kulkarni
6. D.F. Shriver, P. W. Atkins, Shriver & Atkins' Inorganic Chemistry, 4th edition, Oxford University Press, Oxford2006,pp. 189-190
7. Anthony R. West, Basic Solid State Chemistry, 2nd Edition, Wiley, London, 2001, pp. 203-210
8. D.W. Van Krevelen, Properties of Polymers, 2nd revised edition, Elsevier Scientific Publishing Company, Amsterdam-Oxford-New York (1976)
9. Thermoelectric Power in Nanostructured Materials, Kamakhya Prasad, **Bhattacharya**, Sitangshu
10. Electrical Resistivity of Thin Metal Films by Peter Wißmann Professor, Hans-Ulrich Finzel Professor,223(2007) ISBN: 978-3-540-48488-2

CPP103: Project (Credits: 2) **(24)**

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